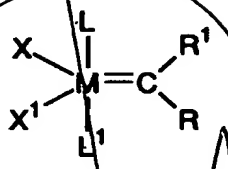
CLAIMS

What is claimed is:

1. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

2. A compound according to claim 1, wherein the substituted alkyl includes one or more functional groups selected from the group consisting of aryl, alcohol, thiol, ketone, aldehyde,

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ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

3. A compound according to claim 1, wherein the substituted aryl includes one or more functional groups selected from the group consisting of alkyl, aryl, alcohol, thiol, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

4. A compound according to claim 1 wherein R is selected from the group consisting of

(a) hydrogen;

(b) C_1-C_{20} alkyl;

(c) aryl;

(d) C_1-C_{20} alkyl substituted with one or more groups selected from the group consisting of aryl, halide, hydroxy, C_1-C_{20} alkoxy, and C_2-C_{20} alkoxycarbonyl; and

(e) aryl substituted with one or more groups selected from the group consisting of C_1-C_{20} alkyl, aryl, hydroxyl, C_1-C_5 alkoxy, amino, nitro, and halide.

5. A compound according to claim 4, wherein R is phenyl or phenyl substituted with a group selected from the group consisting of chloride, bromide, iodide, fluoride, $-NO_2$, $-NMe_2$, methoxy, and methyl.

6. A compound according to claim 5, wherein R is phenyl.

7. A compound according to claim 4, wherein R is selected from the group consisting of hydrogen, methyl, ethyl, n-butyl, iso-propyl, $-CH_2Cl$, $-CH_2CH_2CH_2OH$, and $-CH_2OAc$.

8. A compound according to claim 1, wherein L and L^1 are independently selected from the group consisting of phosphine, sulfonated phosphine, phosphite, phosphinite, phosphonite, arsine, stibine, ether, amine, amide, sulfoxide, carboxyl, nitrosyl, pyridine, and thioether.

9. A compound according to claim 8, wherein L and L^1 are phosphines independently selected from $PR^3R^4R^5$ wherein R^3 is selected from the group consisting of secondary alkyl and cycloalkyl and wherein R^4 and R^5 are independently selected

from the group consisting of aryl, C_1-C_{10} primary alkyl, secondary alkyl, and cycloalkyl.

10. A compound according to claim 9, wherein L and L^1 are independently selected from the group consisting of -$P(cyclohexyl)_3$, -$P(cyclopentyl)_3$, and -$P(isopropyl)_3$.

11. A compound according to claim 8, wherein L and L^1 are both -$P(phenyl)_3$.

12. A compound according to claim 8, wherein L and L^1 are the same.

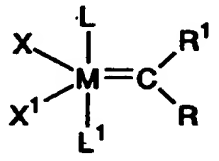
13. A compound according to claim 1, wherein X and X^1 are independently selected from the group consisting of halogen, hydrogen; C_1-C_{20} alkyl, aryl, C_1-C_{20} alkoxide, aryloxide, C_3-C_{20} alkyldiketonate, aryldiketonate, C_1-C_{20} carboxylate, aryl or C_1-C_{20} alkylsulfonate, C_1-C_{20} alkylthio, C_1-C_{20} alkylsulfonyl, or C_1-C_{20} alkylsulfinyl; each optionally substituted with C_1-C_5 alkyl, halogen, C_1-C_5 alkoxy or with a phenyl group optionally substituted with halogen, C_1-C_5 alkyl or C_1-C_5 alkoxy;

14. A compound according to claim 13, wherein X and X^1 are independently selected from Cl, Br, I, H; benzoate, C_1-C_5 carboxylate, C_1-C_5 alkyl, phenoxy, C_1-C_5 alkoxy, C_1-C_5 alkylthio, aryl, or C_1-C_5 alkyl sulfonate; each optionally substituted with C_1-C_5 alkyl or a phenyl group optionally substituted with halogen, C_1-C_5 alkyl or C_1-C_5 alkoxy.

15. A compound according to claim 14, wherein X and X^1 are independently selected from the group consisting of Cl, CF_3CO_2, CH_3CO_2, CFH_2CO_2, $(CH_3)_3CO$, $(CF_3)_2(CH_3)CO$, $(CF_3)(CH_3)_2CO$, PhO, MeO, EtO, tosylate, mesylate, and trifluoromethanesulfonate.

16. A compound according to claim 15, wherein X and X^1 are both Cl.

17. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R^1 is hydrogen;

R is a group selected from the group consisting of

(a) hydrogen;

(b) C_1-C_4 alkyl;

(c) phenyl;

(d) C_1-C_4 alkyl substituted with one or more groups selected from the group consisting of halide, hydroxy, and C_2-C_5 alkoxycarbonyl; and

(e) phenyl substituted with one or more groups selected from the group consisting of C_1-C_5 alkyl, C_1-C_5 alkoxy, amino, nitro, and halide;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently phosphines of the formula $PR^3R^4R^5$ wherein R^3 is selected from the group consisting of secondary alkyl and cycloalkyl and wherein R^4 and R^5 are independently selected from aryl, C_1-C_{10} primary alkyl, secondary alkyl and cycloalkyl.

18. A compound according to claim 17, wherein the substituted phenyl is para-substituted.

19. A compound according to claim 18, wherein R is phenyl or phenyl substituted with a group selected from the group consisting of chloride, bromide, iodide, fluoride, $-NO_2$, $-NMe_2$, methoxy, and methyl.

20. A compound according to claim 19, wherein R is phenyl.

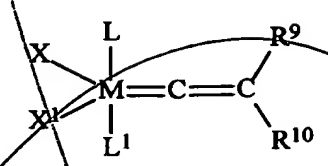
21. A compound according to claim 17, wherein R is selected from the group consisting of hydrogen, methyl, ethyl, n-butyl, iso-propyl, $-CH_2Cl$, $-CH_2CH_2CH_2OH$, and $-CH_2OAc$.

22. A compound according to claim 17, wherein L and L^1 are independantly selected from the group consisting of $-P(cyclohexyl)_3$, $-P(cyclopentyl)_3$, and $-P(isopropyl)_3$.

23. A compound according to claim 17, wherein X and X^1 are both Cl.

24. A compound according to claim 17, wherein R is phenyl, M is Ru, X and X^1 are both Cl, and L and L^1 are the same and are selected from the group consisting of $-P(cyclohexyl)_3$, $-P(cyclopentyl)_3$, and $-P(isopropyl)_3$.

25. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R^9 and R^{10} are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

26. A compound according to claim 25, wherein the substituted alkyl includes one or more functional groups selected from the group consisting of aryl, alcohol, thiol, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

27. A compound according to claim 25, wherein the substituted aryl includes one or more functional groups selected from the group consisting of alkyl, aryl, alcohol, thiol, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

28. A compound according to claim 25, wherein R^9 and R^{10} are independently selected from the group consisting of

(a) hydrogen;

(b) C_1-C_{20} alkyl;

(c) aryl;

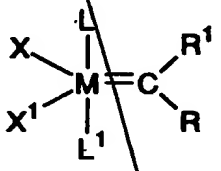
(d) C_1-C_{20} alkyl substituted with a group selected from the group consisting of halide, aryl, alkoxy, and aryloxy; and

(e) aryl substituted with a group selected from the group consisting of halide, alkyl, aryl, alkoxy, and aryloxy.

29. A compound according to claim 25, wherein M is Ru, R^9 and R^{10} are hydrogen, X and X^1 are Cl, and L and L^1 are the same and are selected from the group consisting of -

$P(cyclohexyl)_3$, $-P(cyclopentyl)_3$, $-P(isopropyl)_3$, and $-P(phenyl)_3$.

30. A process for polymerizing cyclic olefins comprising the step of contacting a cyclic olefin with a compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

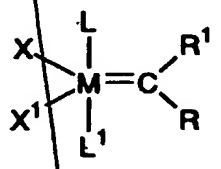
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

31. A process for depolymerizing an unsaturated polymer comprising contacting an unsaturated polymer with a compound of the formula



in the presence of an acyclic olefin, wherein:

M is selected from the group consisting of Os and Ru;

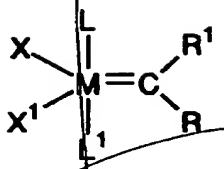
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

32. A process for synthesizing a cyclic olefin comprising the step of contacting a diene with a compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

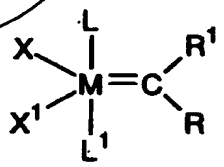
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

33. A process for synthesizing an unsaturated polymer comprising the step of contacting a diene with a compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

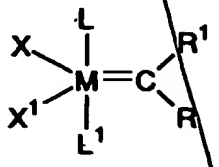
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

34. A process for synthesizing telechelic polymers by metathesis polymerization comprising contacting a cyclic olefin with a compound of the formula



in the presence of an α,ω-difunctional olefin, wherein:

M is selected from the group consisting of Os and Ru;

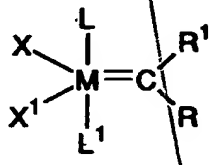
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

35. A process for synthesizing olefins by metathesis comprising contacting an acyclic olefin with a compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

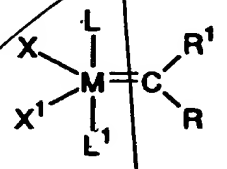
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

36. A process for synthesizing olefins by cross metathesis comprising contacting a first acyclic olefin with a compound of the formula



in the presence of a second acyclic olefin wherein:

M is selected from the group consisting of Os and Ru;

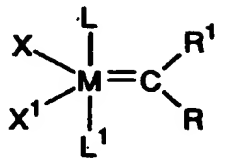
R^1 is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

37. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula $(XX^1ML_nL^1_m)_p$ with a diazo compound of the formula $RC(N_2)R^1$, wherein:

M is selected from the group consisting of Os and Ru;

R and R^1 are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand;

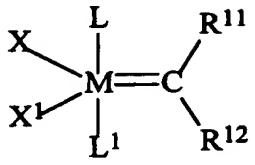
L and L^1 are independently selected from any neutral electron donor;

n and m are independently 0-3, provided n + m = 3; and

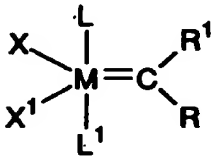
p is an integer greater than 0.

38. A process according to claim 36, wherein R^1 is hydrogen.

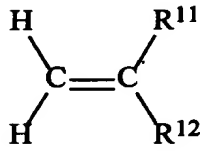
39. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula



with an olefin of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R^1 is hydrogen;

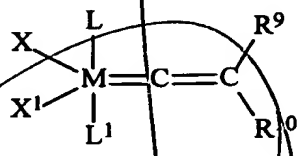
R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

R^{11} and R^{12} are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

40. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula $(XX^1ML_nL^1{}_m)_p$ with an acetylene of the formula R^9CCR^{10}, wherein:

M is selected from the group consisting of Os and Ru;

R^9 and R^{10} are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

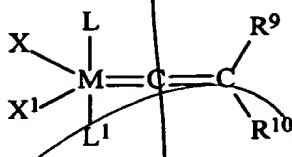
X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor;

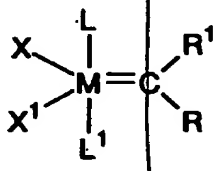
n and m are independently 0-3, provided n+m=3; and

p is an integer greater than 0.

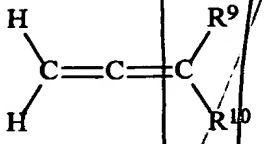
41. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula



with a cumulated olefin of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R^1 is hydrogen;

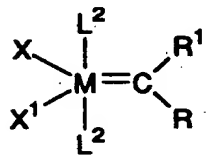
R is selected from the group consisting of hydrogen, substituted or unsubstitued alkyl, and substituted or unsubstituted aryl;

R^9 and R^{10} are independently selected from the group consisting of hydrogen, substituted or unsubstitued alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand; and

L and L^1 are independently selected from any neutral electron donor.

42. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula $(XX^1ML_nL^1_m)_p$ with a diazo compound of the formula $RC(N_2)R^1$ in the presence of a neutral electron donor of the formula L^2, wherein:

M is selected from the group consisting of Os and Ru;

R and R^1 are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X^1 are independently selected from any anionic ligand;

L, L^1, and L^2 are independently selected from any neutral electron donor;

n and m are independently 0-3, provided n + m = 3; and

p is an integer greater than 0.